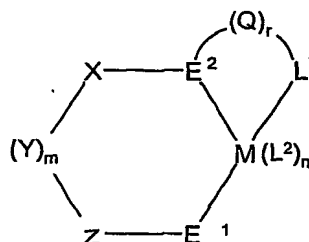


CLAIMS

1. A compound of formula I



I

wherein

each of X, Y, Z is independently selected from O, S, NR¹, CR²R³, N and CR⁴, and where optionally X-Y, Y-Z, Z-E¹ and X-E² each independently form part of a saturated or unsaturated ring system which may be substituted or unsubstituted;

m is 0 or 1;

M is a metal selected from Ti[III], Ti[IV], Fe[II], Fe[III], Co[I], Co[II], Co[III], Ni[II], Cr[III], Mn[II], Mn[III], Mn[IV], Ru[II], Ru[III], Ru[IV], Pd[II], V[II], V[III], V[IV], V[V], Cu[I], Cu[II], Rh[I], Rh[III], Mo[III], Mo[V], Re[I] and Re[II];

each of E¹ and E² is independently selected from O, S, NR⁵, N, P, PR⁶, where at least one of either E¹ or E² carries a formal negative charge;

L² is a one electron donor ligand;

n is zero or an integer such that the compound has an overall charge of zero or +1;

L¹ is NR⁷R⁸, PR⁷R⁸, OR⁷, SR⁷, O, S or NR¹⁶, imidazolyl, pyridinyl, benzimidazolyl or quinolinyl;

each of R¹⁻⁸ and R¹⁶ is independently H or a hydrocarbyl group;

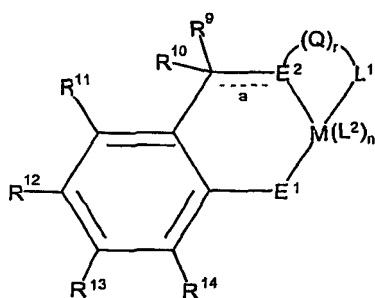
Q is a linker group; and

r is 0 or 1.

2. A compound according to claim 1 wherein L² is selected from halide, hydride, alkyl and cyanide.

3. A compound according to claim 1 or claim 2 wherein L² is chloride or bromide.

4. A compound according to any preceding claim wherein X, Y and Z are each independently selected from CR^2R^3 and CR^4 .
5. A compound according to claim 4 wherein:
 - (i) m is 1, each of X-E^2 and Y-Z is independently a single or a double bond or part of a delocalised π system, and X-Y and Z-E^1 are single bonds; or
 - (ii) m is 1, each of X-Y and Z-E^1 is independently a single or a double bond or part of a delocalised π system, and Z-E^2 and Y-Z are single bonds; or
 - (iii) m is 0, each of X-E^2 and Z-E^1 is independently a single or a double bond or part of a delocalised π system, and X-Z is a single bond;
6. A compound according to any preceding claim wherein m is one, Y-Z is a double bond or part of a delocalised π system, and X-E^2 is a single or a double bond.
7. A compound according to any one of claims 1 to 6 which comprises a compound of formula II

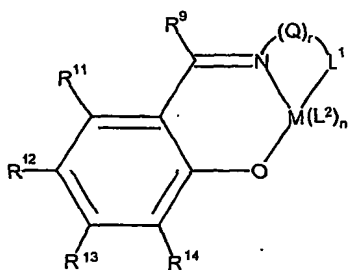


II

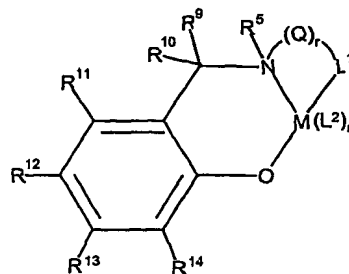
wherein each of R^{9-14} is independently H, a hydrocarbyl group, a halide, ether, thioether, ester, nitro, dialkylamino, or cyano group, and "a" is a double bond or part of a delocalised π system (where one of R^9 or R^{10} is absent), or "a" is a single bond.

8. A compound according to any preceding claim wherein X-E^2 is a double bond or part of a delocalised π system, and E^2 is N.

9. A compound according to any one of claims 1 to 7 wherein $X-E^2$ is single bond and E^2 is NR^5 .
10. A compound according to any preceding claim wherein E^1 is O.
11. A compound according to any preceding claim which comprises a compound of formula III or IV



III

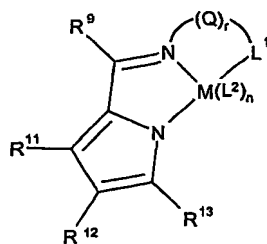


IV

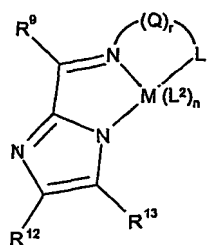
wherein each of R^{9-14} is independently H, a hydrocarbyl group, a halide, ether, thioether, ester, nitro, amino, or cyano group.

12. A compound according to any preceding claim wherein M is Fe.
13. A compound according to any preceding claim wherein L^2 is chloride and n is one or two.
14. A compound according to any one of claims 1-5, 8-10 or 12-13 wherein m is 0, $X-E^2$ and $Z-E^1$ are both double bonds or each form part of a delocalised π system, and $X-Z$ is a single bond.
15. A compound according to claim 14 wherein said compound is of formula V, VI or VII

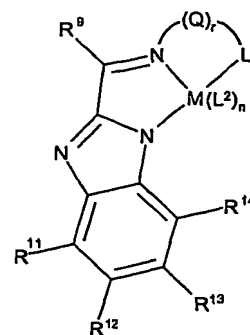
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V



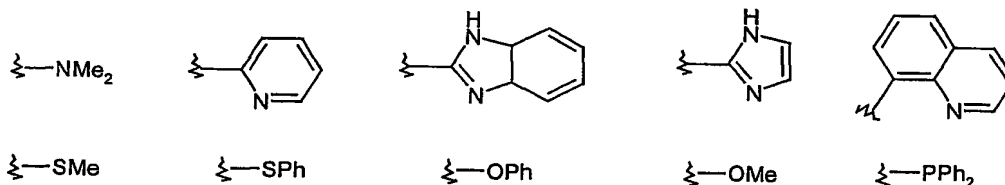
VI



VII

wherein each of R^{9-14} is independently H, a hydrocarbyl group, a halide, ether, thioether, ester, nitro, dialkylamino, or a cyano group

16. A compound according to any preceding claim wherein L^1 is selected from the following: O, -S, -NR¹⁶,



17. A compound according to any preceding claim wherein the linker group Q is - $(CHR^{15})_p$ - or a phenylene group, where p is 1, 2, 3.....10, and each R^{15} is independently H or a hydrocarbyl group.

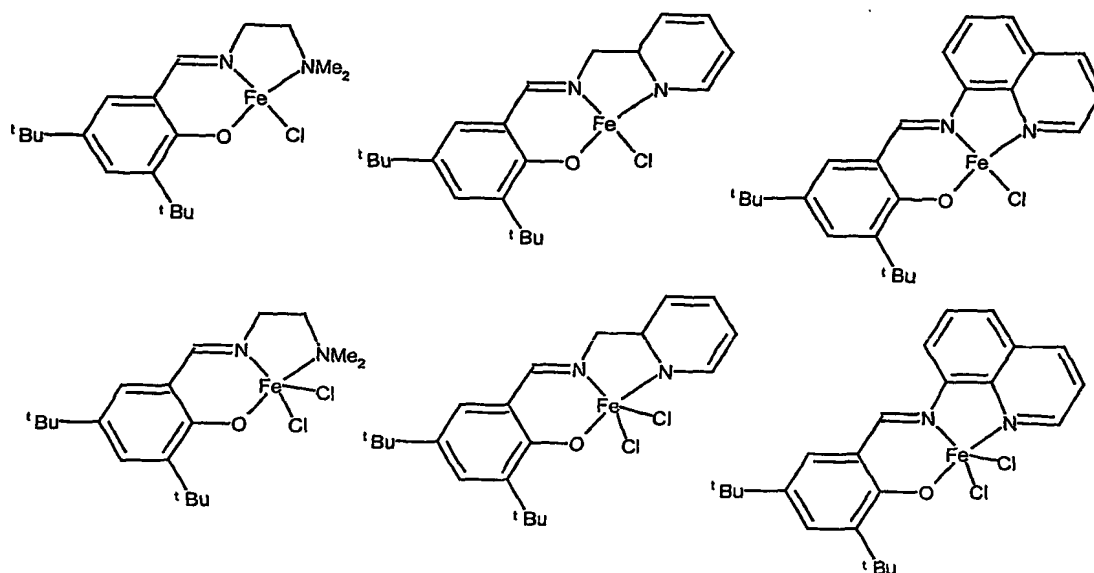
18. A compound according to claim 17 wherein the linker group Q is *o*-phenylene or $-(CH_2)_p$ - where p is 1 or 2.

19. A compound according to any preceding claim wherein r is 1.

20. A compound according to any preceding claim wherein each of R^{1-15} is independently a C_{1-50} alkyl optionally comprising one or more heteroatoms, aryl, or a heteroaryl.

21. A compound according to any preceding claim wherein each of R^{1-15} is independently a C_{1-20} alkyl.

22. A compound according to any preceding claim wherein said compound of formula I is selected from the following:



23. A catalyst composition comprising a compound according to any one of claims 1 to 22 and an initiator.

24. A catalyst composition according to claim 23 wherein the initiator has a radically transferable atom or group.

25. A catalyst composition according to claim 23 or claim 24 wherein the initiator is selected from an alkyl halide optionally containing an electron withdrawing group in the alpha position, a substituted or unsubstituted arenesulphonyl halide, an alkyl dihalide, a sulphonyl halide and a polymer bearing one or more radically transferrable group

26. A catalyst composition according to claim 23 or claim 24 wherein the initiator is selected from CCl_4 , $CHCl_3$, CCl_3Br , 2-bromoethylisobutyrate, 2-

bromoisobutyrophenone, para-toluenesulphonyl chloride, phenoxybenzene-4,4'-disulphonyl chloride, 1,3-benzene disulphonyl chloride.

27. A catalyst composition according to claim 23 or claim 24 wherein the initiator is AIBN.
28. A catalyst composition according to any one of claims 23 to 27 wherein the compound of formula I is supported on an inorganic or organic solid support.
29. Use of a compound according to any one of claims 1 to 22, or a catalyst composition according to any one of claims 23 to 28, for polymerising a radically polymerisable monomer.
30. A process for polymerising a radically polymerisable monomer, said process comprising contacting a catalyst composition according to any one of claims 23 to 28 with a radically polymerisable monomer, optionally in the presence of a solvent.
31. A process according to claim 30 wherein the radically polymerisable monomer is selected from one or more of the following: C₂₋₈ alpha olefins, optionally substituted conjugated dienes, acrylic acid, acrylic anhydride, (meth)acrylamides, vinyl halides, (meth)acrylonitrile, (meth)acrylate esters of C₁₋₂₀ alcohols, vinyl esters of C₁₋₂₀ alcohols, vinyl amides having up to 8 carbons, vinyl ketones having up to 8 carbons, vinyl substituted aryls.
32. A process according to claim 30 or claim 31 wherein the radically polymerisable monomer is an acrylate selected from the following: methyl acrylate, ethyl acrylate, butyl acrylate, 2-ethylhexyl acrylate, isobornyl acrylate, and functional derivatives thereof such as 2-hydroxy ethyl acrylate, 2-chloro ethyl acrylate.
33. A process according to claim 30 or claim 31 wherein the radically polymerisable monomer is a methacrylate selected from the following: methyl methacrylate, ethyl methacrylate, butyl methacrylate, 2-ethylhexyl methacrylate,

isobornyl methacrylate, 2-hydroxy ethyl methacrylate, 2-chloro ethyl methacrylate, 2-hydroxypropyl methacrylate, (HPMA) 2-morpholinoethylmethacrylate (MEMA), 2-(dimethylamino)ethyl methacrylate (DMA), glycerol monomethacrylate (GMA), methoxy capped oligo(ethyleneglycol) methacrylate (OEGMA), poly(ethyleneglycol) methacrylate (PEGMA), glycidyl methacrylate.

34. A process according to claim 30 or claim 31 wherein wherein the radically polymerisable monomer is a (meth)acrylamide selected from the following: (meth)acrylamide, N-methyl (meth)acrylamide and, N,N'-dimethyl (meth)acrylamide.
35. A process according to claim 30 or claim 31 wherein the radically polymerisable monomer is selected from the following: styrene, methyl acrylate, methyl methacrylate, 2-hydroxypropyl methacrylate, (HPMA) 2-morpholinoethylmethacrylate (MEMA), 2-(dimethylamino)ethyl methacrylate (DMA), glycerol monomethacrylate (GMA), methoxy capped oligo(ethyleneglycol) methacrylate (OEGMA), poly(ethyleneglycol) methacrylate (PEGMA) and glycidyl methacrylate.
36. A process according to any one of claims 30 to 35 wherein the ratio of initiator to radically polymerisable monomer is from $2 \times 10^{-3}:1$ to $1 \times 10^{-4}:1$.
37. A process according to any one of claims 30 to 35 wherein the ratio of initiator to radically polymerisable monomer is from $1 \times 10^{-3}:1$ to $1.6 \times 10^{-4}:1$.
38. A process according to any one of claims 30 to 35 wherein the ratio of initiator to radically polymerisable monomer is from $4 \times 10^{-4}:1$ to $2 \times 10^{-4}:1$.
39. A process according to any one of claims 30 to 38 wherein the ratio of initiator to the compound of formula I is from $1 \times 10^{-4}:1$ to 10:1.
40. A process according to any one of claims 30 to 39 wherein the ratio of initiator to the compound of formula I is from $1 \times 10^{-1}:1$ to 5:1.

41. A process according to any one of claims 30 to 40 wherein the polymerisation takes place at a temperature of from about -20°C to 200°C .
42. A process according to any one of claims 30 to 41 wherein the polymerisation takes place in the presence of a Lewis acid activator.
43. A process according to claim 42 wherein the Lewis acid activator is an aluminium alkyl, an aluminium alkoxide, an aluminium halide an alkyl zinc reagent, or a borane.
44. A process according to claim 43 wherein the Lewis acid activator is selected from methyl aluminium, bis(2,6 di-tert-butylphenoxide), aluminium tris(iso-propoxide), aluminium trichloride, diethyl zinc, BPh_3 and $\text{B}(\text{C}_6\text{F}_5)_3$.
45. A process according to any one of claims 42 to 44 wherein the ratio of activator to the compound of formula I is from 1:1 to 10:1.
46. A process according to any one of claims 29 to 44 wherein the polymerisation is carried out in bulk, solution, emulsion, suspension or in the gas phase.
47. A polymerisation mixture comprising a catalyst composition according to any one of claims 23 to 28 and a radically polymerisable monomer as defined in any one of claims 31 to 35, which optionally further comprises a solvent and/or a Lewis acid activator.